

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Czujniki i komunikacja światłowodowa**
 Name in English: **Fiber Optics Communications and Sensors**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Control in Electrical Power Engineering**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052140**
 Group of courses: **NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|--|----------------------|---------|----------------------|---------|---------|
| Number of hours of organized classes in University (ZZU): | 30 | | 30 | | |
| Number of hours of total student workload (CNPS): | 60 | | 30 | | |
| Form of crediting: | crediting with grade | | crediting with grade | | |
| For group of courses mark (X) final course: | | | | | |
| Number of ECTS points: | 2 | | 1 | | |
| including number of ECTS points for practical (P) classes : | | | 1 | | |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 1.40 | | 0.70 | | |

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has structured and theoretically formed knowledge necessary to understand phenomena related to fiber optics and communications
2. Student has a basics knowledge on electromagnetic field theory
3. Is able to select properly, to connect as well as to coordinable performance of elements and fiber sensors in measuring transmission networks
4. Is able to perform properly and effectively basic research on operation parameters of both active and passive optoelectronic elements
5. Is able to conduct work in a team and understands the need for continuous education

SUBJECT OBJECTIVES

- C1. Acquaintance of student with basic knowledge necessary to understand physical phenomena related to optoelectronic transmission of signals
- C2. Acquaintance of student with modern structures of optoelectronic elements as well as with ways of processing and data transmission in optical networks
- C3. Creation of skills and ability to create modern technique methods and measuring tools to test and design fiber optics communication networks
- C4. The acquisition of practical knowledge and skills to apply and to complete fiber optics circuits carrying out measurements and preparation of test protocols

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

PEU_W01 Knows structure and specifics of optical path work

PEU_W02 Has knowledge about optical phenomenon and optical elements dedicated for optical transmission

relating to skills:

PEU_U01 Is able to precise purpose and scope of research, project measurement circuit and select measurement equipment

PEU_U02 Is able to elaborate results and determine conclusions if about fiber guide condition

relating to social competences:

PEU_K01 Is conscious about responsibility for his own work and is willing to acknowledge teamwork rules

PROGRAMME CONTENT

| Form of classes - lecture | | Number of hours: |
|---------------------------|---|------------------|
| Lec 1 | Acquaintance with the subject, its program and the requirements of completion | 2 |
| Lec 2 | Principles of wave theory of light propagation | 2 |
| Lec 3 | Dielectric light guides, properties, basic parameters, fabrication | 2 |
| Lec 4 | Problems of effective propagation of the light wave in fiber guides | 2 |
| Lec 5 | Mechanisms of power losses in fiber guides: dispersion, refraction | 2 |
| Lec 6 | Properties, classifications and operational parameters of the fiber guides | 2 |
| Lec 7 | Light-emitting diodes (LED) as the light-wave source | 2 |
| Lec 8 | Laser diodes (LD) as the light-wave source | 2 |
| Lec 9 | Photodiodes, phototransistors and photoresistors in detection systems of the light-wave | 2 |
| Lec 10 | Splices and optical connectors | 2 |
| Lec 11 | Auxiliary, passive elements in fiber-optics networks and systems | 2 |
| Lec 12 | Expanding optical system capacity by multiplexing | 2 |
| Lec 13 | Digital and analog modulation of optical signals | 2 |
| Lec 14 | Optical phenomena employed in fiber sensors | 2 |
| Lec 15 | Completion quiz | 2 |
| Total hours: | | 30 |

| Form of classes - laboratory | | Number of hours: |
|------------------------------|---|------------------|
| Lab 1 | Introduction to the rules of safety (BHP) and to internal regulations applicable in the lab. Determination of completion criteria. General learning in the lab. Stands and acquaintance with physical models of optical and optoelectronics elements as well as with performance criteria | 2 |
| Lab 2 | Measurement of attenuation of a multisegment fiber optics transmission system | 2 |
| Lab 3 | Attenuation measurement of optical fiber guides | 2 |
| Lab 4 | Testing of optical polarizer | 2 |
| Lab 5 | Investigation of radiation angular characteristics of semiconductor lasers | 2 |
| Lab 6 | Investigation of output spectrum and light-current characteristics of optical light source | 2 |
| Lab 7 | Investigation of matching efficiency of optical connectors | 2 |
| Lab 8 | Communication in BPL smart meters model (TCP/IP) | 2 |
| Lab 9 | Communication in PLC smart meters model (PRIME) | 2 |
| Lab 10 | Communication between devices using the MODBUS protocol (RS485) | 2 |
| Lab 11 | Local Power Protection Operator - local point of the Control and Supervision System (SCADA) | 2 |
| Lab 12 | GOOSE communication - IEC61850 compliant communication - Part I | 2 |
| Lab 13 | MMS communication - introduction to IEC61850 compliant communication - part II | 2 |
| Lab 14 | Access Gateway - communication (using DNP3 protocol) with remote monitoring center | 2 |
| Lab 15 | Completion and arrears exercises | 2 |
| Total hours: | | 30 |

TEACHING TOOLS USED

- N1. Lecture with the use audiovisual techniques multimedia presentations, transparencies
- N2. Laboratory measurements on physical models of the fiber optic elements and using PSP devices, conducted in the traditional manual in the groups

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i> | Educational effect number | Way of evaluating educational effect achievement |
|---|---------------------------|--|
| F1(W) | PEU_W01 PEU_W02 | Oral or written completion test |
| P(W) | P=F1 | |
| F1(L) | PEU_U01 | Checking and assessment of preparation for lab exercises |
| F2(L) | PEU_U02 | Evaluation of reports of performed exercises |
| P(L) | P=0,3F1+0,7F2 | |

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| PRIMARY AND SECONDARY LITERATURE |
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| PRIMARY LITERATURE: |
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| Chai Yeh, Hanbook of Fiber Optics – Theory and Applications, Academic Press. Inc, London 1990. Hornet J.L., Optical Signal Processing, Academic Press, Inc. London 1990. Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa 2004. Handbook of Optics Volume I-V, Mc Graw Hill Companies Inc.,Third Edition, USA 2010 |
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| SECONDARY LITERATURE: |
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| Gagliardi R.M., Karp S., Optical Communications, Willey-int.Pub. CIGRE Working Group 35.04, optical Cable Selection fo Electricity Utilities, Febr. 2001 |
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| SUBJECT SUPERVISOR |
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| Grzegorz Wiśniewski, grzegorz.wisniewski@pwr.edu.pl |
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